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# Two new freshwater species of *Annulatascaceae* from China

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Abstract — Two new species belonging to *Annulatascaceae* are described and illustrated on submerged wood from a freshwater stream. *Annulatascus menglensis,* differentiated from other *Annulatascus* species by its hyaline ascomatal neck, is also characterized by cylindrical asci with a large bipartite refractive J– apical ring and hyaline fusiform ascospores without sheath or appendages. *Aqualignicola vaginata,* which is distinguished from *A. hyalina* in producing a gelatinous sheath surrounding the unicellular hyaline ascospores, is further characterized by its membranous ascomata with lanceolate setae that surround the neck, long cylindrical asci with a relatively large apical ring.

Key words —aquatic, *Ascomycota*, fungi, taxonomy

## Introduction

Freshwater fungi are an important ecological group because of their indispensable function as decomposers in freshwater ecosystems (Wong et al. 1998a); they also have potential application in producing various and useful bioactive secondary metabolites (Bucher et al. 2004, Zhang et al. 2008, Hosoe et al. 2010, Dong et al. 2011). Freshwater fungi are however, relatively poorly investigated comparing to their terrestrial counterpart. Until recently, freshwater fungi had been reported mainly from Europe, North America, and Southeast Asia (Cai et al. 2006b, Raja et al. 2009). Although China has a high biodiversity of fungi and abundant freshwater resources, investigation of freshwater fungi has been mostly restricted to Hong Kong and Yunnan Province.

*Annulatascaceae* S.W. Wong et al. comprises many freshwater genera (Vijaykrishna et al. 2006). The family is characterized morphologically by dark

brown or black ascomata with ostiolate necks, long cylindrical unitunicate asci with a relatively massive, refractive apical ring, and uniseriate, hyaline to brown, fusiform or ellipsoidal ascospores (Wong et al. 1998b, Ho & Hyde 2000). Seventy-five species representing 21 genera are currently placed in *Annulatascaceae* (Kirk et al. 2008).

Our research group has focused on investigating the diversity of freshwater fungi in China for over ten years (Hyde et al. 2000, Luo et al. 2004, Cai et al. 2005, 2008, Hu et al. 2007, 2010a, b). During our continuing investigation, two undescribed ascomycetes belonging to the *Annulatascaceae* were collected on submerged wood and are described and illustrated in this paper.

## Materials & methods

D.M. Hu, who has investigated freshwater ascomycetes on submerged woody material in the southern provinces of China (including Guizhou, Jiangxi and Yunnan provinces) since 2008, has collected 875 samples from streams, lakes, ditches, and ponds. After return to the laboratory, the samples were incubated following Cai et al. (2006a). Samples were examined for fungal fruiting bodies under a dissecting microscope (Leica MZ16A) during incubation. Observations and photographs were prepared from materials mounted in water under a compound microscope (Nikon E800). Single spore isolation as outlined by Choi et al. (1999) was attempted but unsuccessful. Herbarium specimens of the fungal taxa described in this study are deposited in the International Fungi Research and Development Centre (IFRDC).

## Taxonomy

***Annulatascus menglensis*** D.M. Hu, L. Cai & K.D. Hyde, **sp. nov.** Plate 1

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Differs from other *Annulatascus* species by its hyaline neck.

Type: China, Yunnan Province, Mengla, Wudaoban Stream, 21°24′N 101°36′E, alt: 660 m, 3 April 2009, D.M. Hu (**Holotype**, IFRDC 023-002).

Etymology: *menglensis* refers to the collecting site, Mengla, a county in southern China.

Ascomata 180–200 high, 120–150 μm in diam., subglobose to ellipsoidal, superficial, solitary, ostiolate, black, coriaceous. Neck 150–340 × 40–60 μm, cylindrical, hyaline, membranous, periphysate. Peridium composed of compressed cells, outer layers dark brown, inner layers hyaline. Paraphyses ca. 5–6 μm wide, broad at the base and tapering towards the apex, hyaline, septate, smooth-walled, simple, longer than asci. Asci 115–163 × 10–13 μm, 8-spored, cylindrical, unitunicate, persistent, pedicellate, with a large bipartite, refractive, J– apical ring, ca. 3 μm high, 4 μm in diam. Ascospores 21–25 × 8–10 μm (mean = 23.8 × 8.5 μm, n = 30), uniseriate, overlapping, fusiform, with acute ends, hyaline, aseptate, guttulate, smooth, thin-walled, without sheaths or appendages.

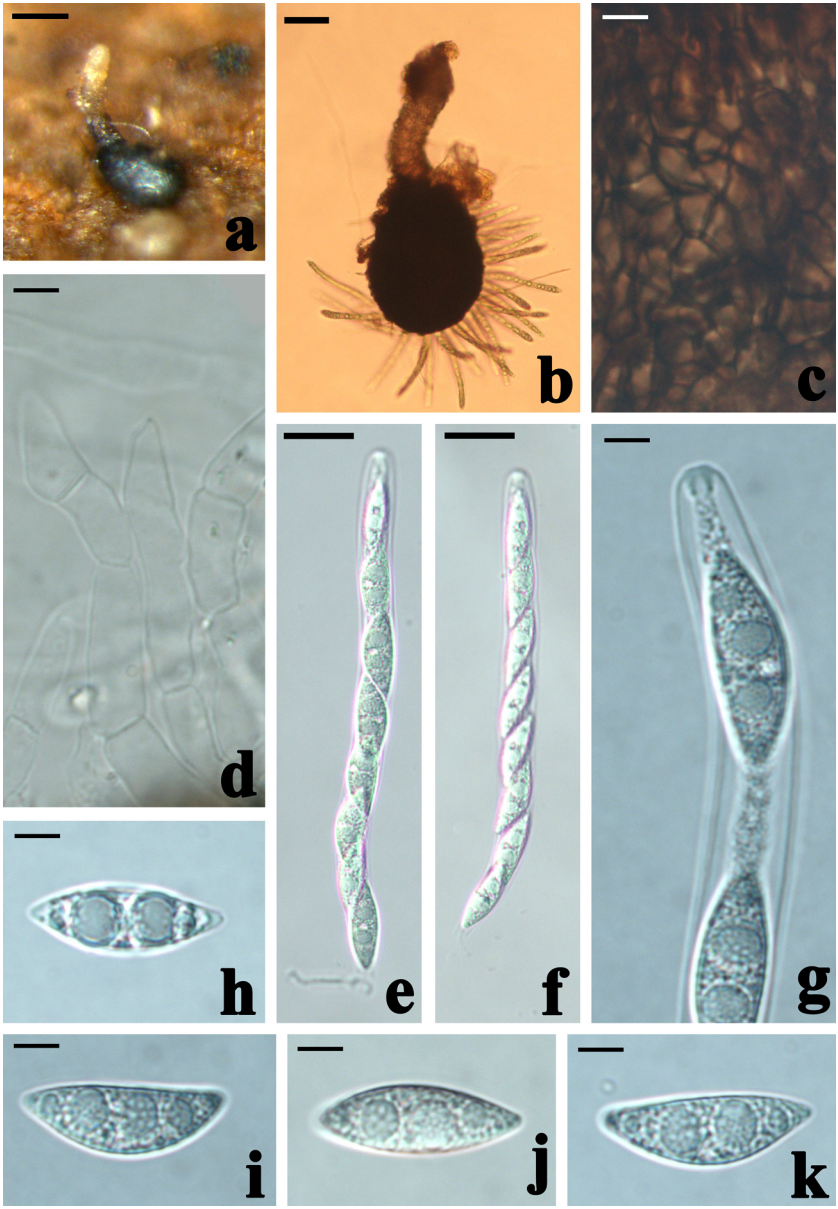


Plate 1. *Annulatascus menglensis* (from holotype). a. Ascoma on submerged wood. b. Squash mount of an ascoma. c. Peridium comprising angular cells in surface view. d. Paraphyses. e–f. Asci. g. Upper part of an ascus showing the apical ring. h–k. Ascospores. Scale bars: a = 100 µm, b = 50 µm, c–d = 5 µm, e–f = 20 µm, g–k = 5 µm.

Habitat & distribution— Saprobic on submerged wood in fresh water in China.

Additional specimens examined: **CHINA**. **Yunnan Province**: Mengla, Wudaoban Stream, 21°24′N 101°36′E, alt. 660 m, 3 April 2009, D.M. Hu (IFRDSC 002-017, IFRDSC 002-018).

Comments — *Annulatascus menglensis* has black, coriaceous ascomata and cylindrical asci with a large bipartite, refractive, J– apical ring. It fits well within the generic concept of *Annulatascus* (Hyde 1992). Thus far, 14 species have been included in the genus (Tsui et al. 2002, Barbosa et al. 2008, Abdel-Wahab et al. 2011). The new species resembles *A. velatisporus* K.D. Hyde (Hyde 1992) in having fusiform and aseptate ascospores. However, *A. velatisporus* differs from *A. menglensis* in having larger ascospores (26–42 × 9–12 µm) with a gelatinous sheath. *Annulatascus menglensis* shares similar ascospore dimensions with *A. fusiformis* K.D. Hyde & S.W. Wong (Hyde & Wong 2000), *A. joannae* K.M. Tsui et al. (Tsui et al. 2002), *A. citriosporus* J. Fröhl. & K.D. Hyde (Fröhlich & Hyde 2000), and *A. apiculatus* F.R. Barbosa & Gusmão (Barbosa et al. 2008) but lacks their black necks and mucilaginous sheaths and/or appendages. *Annulatascus lacteus* K.M. Tsui et al. (Tsui et al. 2002), which also has aseptate ascospores without sheath or appendage, differs from *A. menglensis* in having a milky ascomata.

***Aqualignicola vaginata*** D.M. Hu, L. Cai & K.D. Hyde, **sp. nov.** Plate 2

MycoBank MB 563811

Differs from *Aqualignicola hyalina* in having a hyaline ascomatal neck and a gelatinous sheath surrounding the ascospores.

Type: China, Yunnan Province, Mengla, Wudaoban Stream, 21°32′N E101°29′E, alt. 620 m, 2 April 2009, D.M. Hu (**Holotype**, IFRDC 021-043).

Etymology: *vaginata* (= sheath) refers to the mucilaginous sheath surrounding the ascospore.

Ascomata 100–140 µm diam, globose, membranous, brown to black-brown, submerged, solitary. Neck 40–60 µm diam, 200–350 µm long, cylindrical, hyaline, periphysate, covered with setae; setae 15–35 × 4–5 µm, lanceolate, solid, surrounding the neck. Peridium 7–14 µm thick, in surface view of textura angularis, composed of 5 layers of light-brown, pseudoparenchymatous cells. Paraphyses 4–6 µm in diam, 85–100 long, septate, flexuose, hypha-like, numerous, tapering towards the apex, embedded in a gelatinous matrix. Asci 145–156 × 5.5–6.5 µm, 8-spored, cylindrical, pedicellate, unitunicate, apically truncate, with a large, J–, refractive, apical ring. Ascospores 11–15 × 5–6 µm (mean = 13.4 × 5.3 µm, n = 50), uniseriate, ellipsoidal-fusiform, hyaline, aseptate, thin-walled, multiguttulate, with a fan-shaped, hyaline mucilaginous sheath surrounding one end of the ascospores.

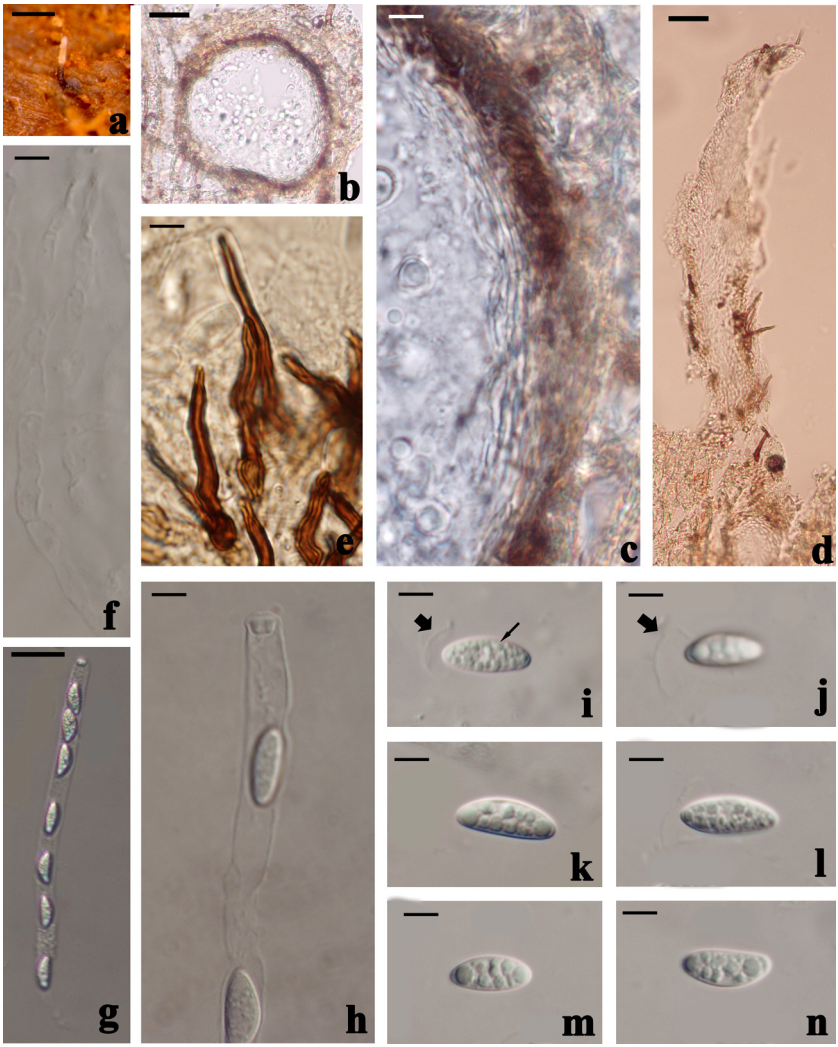


Plate 2. *Aqualignicola vaginata* (from holotype). a. Ascoma on submerged wood. b. Section of an ascoma. c. Peridium. d. Section through a neck. e. Hair on neck. f. Paraphyses. g. Ascus. h. Upper part of an ascus, show the apical ring. i–n. Ascospores (arrows show the mucilaginous sheath and the multiple guttules). Scale bars: a = 100 μm, b = 30 μm, c = 5 μm, d = 30 μm, e, f = 5 μm, g = 20 μm, h–n = 5 μm.

Habitat & distribution — Saprobic on submerged wood in fresh water in China.

Additional specimens examined: **CHINA**. **Yunnan Province**: Mengla, Wudaoban Stream, 21°32′N 101°29′E, alt. 620 m, 2 April 2009, D.M. Hu (IFRDSC 004-003, IFRDSC 004-004, IFRDSC 004-005).

Comments — Previously monotypic, *Aqualignicola* V.M. Ranghoo et al. is characterized by membranous ascomata with a neck surrounded by lanceolate setae, long cylindrical asci with a relatively large apical ring, and hyaline unicellular ascospores (Ranghoo et al. 2001). The new species fits well with the generic concept of *Aqualignicola* but differs from the type species, *A. hyalina,* in having a hyaline ascomatal neck and a mucilaginous sheath surrounding the ascospore. Furthermore, the ascospores and asci of *A. vaginata* are narrower than those of *A. hyalina* (ascospores: 14–15 × 6.25–7.5 µm; asci 9–12 µm diam.). *Aqualignicola vaginata* is also similar to species of *Aquaticola* W.H. Ho et al. (Ho et al. 1999) and *Longicollum* Zelski et al. (Zelski et al. 2011a). However, the species of the latter two genera have glabrous ascomata and lack the lanceolate setae surrounding the neck found in *A. vaginata*. *Aqualignicola vaginata* can be compared to the newly described *Chaetorostrum quincemilense* Zelski et al. (Zelski et al. 2011b) in that both taxa have a hyaline neck covered with setae; however the ascospores of *A. vaginata* are aseptate and much smaller than those of *C. quincemilense* (1–3-septate; 30–38 × 10–12 µm).

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